REMARKS

The Office Action of January 21, 2009, has been carefully studied. Claims 17, 20 and 22-35 currently appear in this application. These claims define novel and unobvious subject matter under Sections 102 and 103 of 35 U.S.C., and therefore should be allowed. Applicant respectfully requests favorable reconsideration and formal allowance of the claims.

What is Claimed

The presently claimed method is an improvement in the known method for welding three-dimensional thermoplastic molded articles by so-called laser through welding. That is, a laser-transmissive join partner is placed onto a laser-absorptive join partner and energy from a laser beam is transmitted through the laser-transmissive join partner to the laser-absorptive join partner, where the laser energy is absorbed. This absorbed energy heats and melts the laser-absorptive join partner. The heat generated in the absorptive join partner is conducted to the laser-transmissive join partner, which is also melted, albeit not simultaneously with the laser-absorptive join partner.

The problem with the known method is shown in Figure 3 of the present application, which illustrates the temperature distribution in the welding area for conventional

laser through welding. As disclosed in the present specification as filed at page 8, lines 20-26, it is clear that, in the conventional laser through welding, the molten phase extends into the transmissive join partner only for a short distance. This means that the process window is very narrow. That is, if there is a slight decrease in the energy absorption in the absorptive join partner, melting of the transmissive join partner ceases or at least diminishes; inevitably resulting in a weakened and/or imperfect weld.

The presently claimed process solves this problem by using secondary radiation of a type different from laser radiation that is applied simultaneously with the laser. This secondary radiation, which is IR or UV radiation, provides additional heat to the **transmissive** partner, not to the join partner. This secondary radiation increases the temperature of the transmissive join partner substantially independently from the energy input by the laser welding beam.

The result of this improvement is shown in Figure 4 of the present application, which makes it clear that the melted phase reaches more deeply into the transmissive join partner as compared with the prior art situation shown in Figure 3, in which only the absorptive join partner is exposed to sufficient radiation. The increase in temperature in the

transmissive join partner comes from the secondary UV or IR radiation, not from an increase in the laser welding energy.

Submitted herewith is a copy of a publication authored by the inventor of the present application, which was published in the international conference "LANE-Laser Assisted Net Shape Engineering" in 2004. This conference was for the exchange of up-to-date scientific results on the application of lasers in production, both in industrial practice and research. In this publication, "Hybrid Laser Welding of Polymers," paragraph 3 broadly discusses the principles and advantages of hybrid welding. Of particular interest are Figures 8 and 9, which deal in detail with the production of a balanced temperature field as provided in the presently claimed method as compared to the conventional laser welding process.

Claim Objections

Claim 17 is objected to because "an outline (K)" appears to be a reference to the figures, and "the group insisting of" appears to be in error.

The present amendment has deleted "(K)" from claim 17 and has substituted "consisting" for "insisting."

Rejections under 35 U.S.C. 112

Claim 20 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

This rejection is respectfully traversed. Claim 20 has been amended to depend from claim 17. In addition, claim 20 has been amended to recite that the secondary radiation is selected from the group consisting of UV and IR radiation.

Art Rejections

Claims 17-20 and 22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al., US 2003/0213552 in view of Kubota et al., US 2003/0090562.

This rejection is respectfully traversed. Chen discloses conventional laser through welding which, as described above, has the problem that the molten phase does not extend very far into the transmissive join partner. Chen discloses a welding process in which, after the melting temperature has been reached, a further point-like laser beam with a high energy density follows the linear radiation zone (paragraph 0010). Thus, two types of laser welding are used in sequence.

Contrary to the Examiner's assertion, Chen does not provide the type of secondary radiation as claimed herein. Chen clearly states that the second point-like laser has the purpose of providing additional energy (i.e. laser energy) for the welding operation. This only means that more laser energy is pumped into the absorptive join partner, there being no ability to homogenize the temperature distribution as in the present invention, such as pictured in Figure 4 of the present application. Chen suffers from the same deficiencies as other conventional laser energy beam welding.

Figures 3 and 4 of the present application show the differences in energy absorption between the prior art (Fig. 3) and the present invention (Fig. 4) wherein electromagnetic energy is applied to both the laser transmissive join partner and when secondary energy is applied to the transmissive join partner. The additional energy Chen applies to the layers is laser energy, which is not the same as claimed herein.
The extra laser energy Chen applies is of the same character as the initial laser energy, and is only designed to increase the energy transmitted to the absorptive join partner. The presently claimed method requires that the secondary radiation be either UV or IR, and the secondary radiation is applied simultaneously to the laser transmissive join partner. This

process ensures that the temperature field through the welding area is homogenized.

Kubota adds nothing to Chen, because Kubota also only deals with a laser through welding method using one radiation source. There is nothing in Kubota that suggests to one skilled in the art that there is a method for perfecting the temperature distribution over the surface of both join partners. As neither Chen nor Kubota discloses or suggests a second radiation which is not laser radiation, there is no way that a combination of the two references even if obvious (not conceded) could reach applicant's claimed subject matter.

Kubota has nothing to do with the problem of homogenizing the temperature, but is directed to reducing the damage done to the surface of the transmissive join partner on top of the absorptive join partner (paragraph 0033). Furthermore, Kubota mentions the problem that the presently claimed method overcomes, namely, the very narrow process temperature window of the welding process (cf. Kubota, paragraph 0017, last sentence).

As compared to the presently claimed process, Kubota proposes a completely different way to solve the cited problems. Kubota does not propose to use additional radiation sources, that is, a primary laser welding beam and a secondary UV or IR radiation source, but rather controls the radiation

by working on the focal point of the welding beam. Kubota uses the so-called "steep focus technique" and tries to concentrate energy along the welding path by varying the beam radius along the beam propagation direction. This is the first control parameter of Kubota.

Further on, Kubota discloses in paragraph 0011 that a disadvantage of conventional laser plastic welding is that the transmissive layer partially absorbs laser energy. Therefore, Kubota disclose selecting different wavelengths that are not absorbed by the transmissive join partner, which is directly contrary to the process claimed herein. Moreover, Kubota discloses in paragraph 0016 that the partial beam absorption in the transmissive layer leads to a bad weld seam quality.

Kubota uses a quite complex optical measure to control the focus, in the form of leading the welding radiation produced by a collimated electromagnetic radiation source (106) through an optical switch or modulator (108), an optical filter band pass (10) and an achromatic lens (114). Thus, again, there is nothing in Kubota regarding using two different types of radiation light sources, one for welding and one for temperature homogenization.

Withdrawal of the rejection is in order and is respectfully requested.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen in view of Kubota and optionally in view of Korte, US 6,444,946.

This rejection is respectfully traversed.

As noted above, Chen does not disclose applying radiation to increase the temperature of the transmissive join partner so as to homogenize the temperature in the area of joining. Kubota adds nothing to Chen which would lead to the present invention, because Kubota does not use two different types of sources of radiation and specifically cautions against heating the transmissive join partner, thus teaching away from the presently claimed process.

Korte adds nothing to the combination of Chen and Kubota, because Korte also works with only one energy beam. This one energy beam penetrates the joint face of the transmissive join partner and does not heat the transmissive join partner, or only slightly heats the transmissive join partner. The beam in Korte impinges the joint face directly juxtaposed, which, due to its physical properties, absorbs the radiation and heats until it melts. The melting phase heats the first joint face of the transmissive join partner (column 2, lines 40-46). It is very clear that Korte only discloses the classical through welding method, which is broadly

discussed in the present specification and which suffers from the same problems, particularly the small process window.

In view of the above, it is respectfully submitted that the claims are now in condition for allowance, and favorable action thereon is earnestly solicited.

Respectfully submitted,

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